

Learning Nonlinear Models of Dynamic Systems

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Abstract—Modeling dynamic systems is an important part in analysing and control of various systems arising either in health sciences or in the engineering world. Recent approaches to learn models from data are the so-called kernel-based methods and SVMs. There are strong relations to the theory of reproducing kernel Hilbert space (RKHS), to principal component analysis and canonic correlation analysis known previously from statistics. In recent form their use was extended from statistics to obtain models for dynamic systems. First we summarise the basics for the reproducing kernel based Hilbert space (RKHS) and the support vector machine (SVM) approaches. Following this it will be shown how some frequently used nonlinear models can be obtained by using these concepts. In the last part we discuss the structure estimation problem, i.e. how to determine the (least) number of features (observables) to describe the nonlinear system with a sparse representation.

Index Terms—nonlinear systems, state space, ARX models, RKHS, SVM, linearisation by immersion